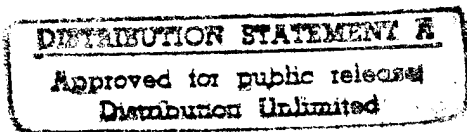


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COMMAND AND CONTROL
AND THE
REVOLUTION IN MILITARY AFFAIRS

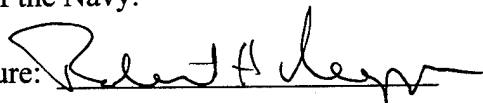
By



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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Joint Military Operations Department.

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Abstract of
COMMAND AND CONTROL
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The Revolution in Military Affairs (RMA) is causing a related revolution in Command, Control, Communications, and Computer(C⁴) systems. The C⁴ system in the 21st Century will provide a plethora of new information to the Operational Commander and will significantly improve decision making. The vision for the new system is contained in the Joint Chiefs of Staff paper "C⁴I for the Warrior." It is a three phased program that emphasizes the process over equipment. The program is jointly focused and driven by the Joint Requirements Oversight Council (JROC) chaired by the Vice Chairman of the Joint Chiefs of Staff. In the era of declining military budgets, the new C⁴ system has the potential of providing exceptional value for the dollar. Challenges that have to be solved include controlling the escalating cost of software development and ensuring standardization among services. Other obstacles include system acceptance by potential users, avoiding information overload, security, training, and maintainability. At the Operational Commander level, decision making will have to be decentralized and doctrine improved. When fully implemented, the new C⁴ system has the potential to dramatically change the way the military operates on the battlefield.

COMMAND AND CONTROL AND THE REVOLUTION IN MILITARY AFFAIRS

ANALYSIS AND PERSPECTIVE FOR THE OPERATIONAL COMMANDER

INTRODUCTION

“...the general unreliability of all information presents a special problem in war: all action takes place, so to speak, in a kind of twilight, which, like fog or moonlight, often tends to make things seem grotesque and larger than they really are. Whatever is hidden from full view in this feeble light has to be guessed at by talent, or simply left to chance. So once again for lack of objective knowledge one has to trust to talent or to luck.”¹

Carl Von Clausewitz, in *On War*

Historical Perspective. In the above quotation the famous military strategist Carl Von Clausewitz laments about how difficult it is to correctly assess *information* gained during war. Clausewitz wrote his defining work of art, *On War*, in an era untouched by the dramatic technological revolution in electronics and communications that is occurring in our world today. Modern technology promises to significantly alter the *art of war* in the 21st Century. The *fog, friction, and chaos* that Clausewitz so eloquently elucidated in his book still exist on the battlefield today as does the *uncertainty* that often clouds the commander's view. Because of his distrust of the intelligence gathering process, Clausewitz argued that information should be viewed cautiously and generally treated as unreliable.²

Today the paradigm is shifting as the technology revolution begins to dramatically reshape the Command, Control, Communications, and Computer (C⁴) information system of the future. *Fog, friction, and chaos* on the battlefield will be minimized, as new systems for receiving, sorting, and reporting real-time information become fully operational. The result will be a much clearer view of the battlefield by the Operational Commander. The clearer view will facilitate quick, decisive movement of forces and significantly increase leverage over any enemy that lacks the technology advantage. This dramatic shift in the balance of power will prove critical to future success on the battlefield.

THE REVOLUTION IN MILITARY AFFAIRS

The Computer Generation. The final two decades of the 20th Century have been shaped by the explosion in technology. Micro-miniature, high-speed computer processors, satellite communications and compressed data technologies have evolved into a system called the *information super highway*. The long predicted but slow to evolve vision of a personal computer in every household is finally within reach.

RMA. The tremendous advances in technology created a phenomenon in the military known as the *Revolution in Military Affairs* or RMA. Fortunately for the U.S. Military, the revolution is occurring during a period of major restructuring and redefining of roles, functions and missions. This reorganization was necessitated by the surprise implosion of the former Soviet Union and the end of the Cold War. The U.S. Military is also facing a related revolution—a ballooning national debt that has forced an ever decreasing defense budget. Decreasing budgets have resulted in an era of *downsizing* that will continue to significantly

reduce both forces and infrastructure until the end of the decade.³ As forces and infrastructure decline, advances in technology have lessened the burden and have helped the military keep pace in the rapidly changing world. No where has this been more true, than in the area of Command and Control (C²) technology.

Information Flow. The flow of information on the tactical, operational, and strategic levels of war is as critical a factor in modern warfare as it was in Clausewitz's time. Ensuring unencumbered and uninterrupted flow of information on one side while impeding or interrupting the flow on the other is a potential force multiplier that can provide significant advantages on the battlefield. Modern C⁴ systems can improve the critical flow of information and significantly improve the *art* of Command and Control.

Focus. This paper will discuss and analyze the RMA vision to facilitate an understanding of how the revolutionary new C⁴ system evolved into the cornerstone for the 21st Century force. Next, it will discuss criticisms of C⁴ technology and offer counter-arguments. Finally, it will discuss C⁴ employment challenges for the Operational Commander and offer recommendations and conclusions.

DEFINING THE TERMS

"The measure of command and control effectiveness is simple: either our command and control works faster than the enemy's decision and execution cycle or the enemy will own our command and control."⁴

Fleet Marine Force Manual (FMFM)-- 3

The Baseline. Before discussing the intricacies of C⁴ systems, it is important to have a fundamental understanding of the differences between "Command and Control" and

“Command, Control, Communications and Computers.” The Joint Chiefs of Staff (JCS) Pub

1-02 defines “command and control” as:

The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.⁵

The JCS Pub 6-0 defines “command, control, communications, and computer systems” as:

Integrated systems of doctrine, procedures, organizational structures, personnel, equipment, facilities, and communications designed to support a commander’s exercise of command and control across the range of military operations.⁶

What is important to note, is that C² is the “exercise of authority and direction” and C⁴ is the “systems....designed to support” that exercise. This is an important principle that many critics of the revolution in C⁴ technology tend to overlook. This point will be expounded upon again.

THE VISION FOR THE 21st CENTURY

“Improved interoperability, greater reliability, and enhanced security—achieved through rapid advances in information technology—are essential for effective command and control as we enter the 21st Century. Automated information systems and networks provide the predominant source from which the warfighter generates, receives, shares, and utilizes information. The synthesis of advanced C⁴ capabilities and sound doctrine leads to battlespace knowledge essential to success in conflict.”⁷

General John M. Shalikashvili, Chairman of the Joint Chiefs of Staff

History of the Concept. Efforts to facilitate joint interoperability and improve C⁴ systems were started shortly before the Gulf War. The Navy took the lead by initiating the

Copernicus architecture concept in 1990. *Copernicus* was a blueprint or a process for capturing technological change and in itself was not a system. It recognized that current acquisition strategies could not work quickly enough to stay abreast of the innovations in technology. Thus, to successfully integrate rapid advances into the warfighting system required a new way of doing business. *Copernicus* attempted to formulate a realistic approach for completing this task and also addressed standardization and modernization of C⁴ systems with a focus on joint operations.⁸

The Army was slower to embrace the new C⁴ concept because of valid concerns over the complexity of its command and control functions. Following the success of Desert Storm, the Army published *Army Enterprise Strategy* in 1993. The paper addressed the Army's C⁴ architecture concept and stressed the movement and synchronization of a multitude of friendly "movers, shooters, and emitters" on a digitized battlefield.⁹

In 1994, the Air Force followed the Navy's *Copernicus* concept with its own C⁴ blueprint called *Horizon*. The conceptual goal was to create an integrated network, called *infosphere* by the Air Force, that met all joint requirements. One controversial aspect of the *whitepaper* was that the Air Force proposed itself as the custodian of the future joint C⁴ system.¹⁰ This has caused some *turf war* problems in its relationship with the Navy that have not yet been resolved.

Impact of Gulf War. The Gulf War demonstrated the tremendous offensive leverage that could be gained over an enemy by superiority in C⁴ systems. Coalition forces were able to rapidly exchange and analyze thousands of bits of information enabling near simultaneous strikes at the tactical, operational, and strategic levels of war.¹¹ The success of modern command and control systems against the Iraqi military caused both Congress and the U.S.

Military to reanalyze procurement policies and to dramatically accelerate the RMA in the post-war era.

C⁴I for the Warrior. In 1992 the Joint Chiefs of Staff published this evolutionary document that set forth a concept for the acquisition and implementation of an entirely new and jointly-fused C⁴I (the “I” added Intelligence into the equation) system for the 21st Century. The paper established a *roadmap* comprised of three phases:

- Quick Fix Phase.
- Midterm Phase.
- Objective Phase.

The Quick Fix Phase addressed policy, doctrine, strategy, standardization, acquisition, testing, and organizational matters and was completed in 1993. The Midterm Phase will soon conclude when the Global Command and Control System (GCCS) becomes operational in the summer of 1996. The Objective Phase is scheduled to be completed early in the 21st Century. When complete, all of the multitude of C⁴ systems will be successfully integrated into one common system that provides the *warrior* with “fused, real-time situational awareness knowledge in all of its dimensions, fully integrated, horizontally and vertically.”¹²

The JROC. The three-phased approach for acquiring the new C⁴ system was unique from any other major military program in history. This uniqueness can be attributed to the Goldwater-Nichols Act that became law in 1986. The main objective of the Act was to force the Military Services to work together as a team in a joint environment. However, a bonus was realized when the “requirements” provisions of the Act lead to the formation of the Joint Requirements Oversight Council (JROC), chaired by the Vice Chairman of the Joint Chiefs of Staff.

The creation of the JROC lead to a fundamental change in way the military does business. Because of the power invested in the JROC, the JCS can now control the military requirements for each service. This means, the Chairman of the JCS can personally influence the Planning, Programming, and Budgeting System (PPBS) for each of the services.¹³ In layperson terms, this means the Services still control the funds, but the Chairman through the JROC process can dictate how, where, and when the money is spent. The JROC process also ensures new systems are joint-driven vice service-driven. An additional benefit is that commonality of hardware, and standardization of doctrine, software, and training can be enforced throughout the Department of Defense. Due in large part to the Goldwater-Nichols Act, the revolution in C⁴ is no longer just a concept, but a modern system that will soon be available to every Operational Commander, his or her staff, and the entire armed forces of the United States.

THE SYSTEM OF SYSTEMS

"This new system-of-systems capability is at the heart of the American revolution in military affairs. It embodies a new appreciation of joint military operations, for the system-of-systems and the revolution itself depend ultimately on contributions from all the Military Services, a common appreciation of what we are building, and a common military doctrine."¹⁴

Adm. William A. Owens, USN, Vice Chairman of the JCS

Multiple Systems. The advanced C⁴ system is actually part of a three-prong effort being fostered by the JROC and Department of Defense. It is complemented by advanced Intelligence, Surveillance, and Reconnaissance (ISR) systems and advanced Precision-guided Munitions (PGMs). Together, the technological programs that comprise these three areas are

what Admiral Owens¹⁵ calls the *system-of-systems* in his quotation. It is the interaction and synergism of these three systems that are the driving force behind the RMA.¹⁶

Where Does C⁴ Fit? The purpose of the C⁴ portion of the equation is to convert the information gained from ISR systems “into a deeper knowledge and understanding of the battlespace...” and to then, “...convert the understanding of the battlespace into missions and assignments designed to alter, control, and dominate that space.”¹⁷ Finally, the PGMs stage will take the knowledge generated from the first two processes and convert that knowledge into action on the battlefield. It will do this not only by the precision use of weapons, but also by the precision use of force.

Will It Work? The concept appears solid on the surface. The JCS controlled program emphasizes a service unified strategy and process over the hardware. To save both time and money, Commercial Off-The-Shelf (COTS) technology will be used as much as possible. Also, architecture and software languages will be standardized. Finally, the strategy strives for a system that works instead of the best system possible. Vice Admiral Cebrowski, Director of C⁴ Systems on the Joint Staff (J-6) said it best, “I don’t want a system—I want a process. I don’t want to buy this years state of the art, which becomes next year’s state of the shelf, which becomes the following year’s rubbish. I want a process that allows continuous regeneration.”¹⁸

Some Challenges. Adequate funding and controlling cost are two of the biggest challenges facing C⁴ system development. Although hardware costs are remaining fairly constant, software costs are rapidly escalating. What is especially frustrating, is that most of the software costs are associated with the interoperability issue. For the program to be successful, software costs must be shifted away from error correction and toward design and

requirements definition. This will consume a significant portion of the overall effort for the foreseeable future. A quantitative measure of the value and importance of the C⁴ *system of systems* to the 21st Century military was stated very succinctly by Admiral Cebrowski, "...if you cannot do command and control well, then almost everything else you are doing is irrelevant. This is an entry-fee item."¹⁹ In other words, without dominance in command and control, the battle is already lost.

OPPOSING VIEWPOINTS

"Some of the post-mortems of the American experience in Vietnam argue the reason the United States could put men on the moon, but could not *win* the Vietnam conflict was because, unlike the inanimate moon, the opponent in Vietnam *fought back*."²⁰

Potential Problems. Not everyone is in agreement that the tremendous expenditures on C⁴ technology are the right direction for the military to take. There are many skeptics who mistrust technology as the panacea for budgetary ills and correctly point out that there are potential shortcomings. One of the major arguments is that too much information, better called information overload, may actually hinder the decision making process vice aid it. Filtering programs, combined with low-level, computer-aided decision processing are two methods currently being evaluated for reducing information overload. The key here is not to filter out critical information by mistake or have the computer make decisions in a vacuum outside the user's purview. The subject of information overload will be addressed again in the operational concerns section of this paper.

Others argue that U.S. Military leadership is too optimistic about not only our superiority in technology but also its potential impact. "Unfortunately, technology increasingly is presented as promising decisive results that it may be incapable of delivering" wrote a Navy Captain in a recent article critical of putting too much emphasis on technology. He further cautioned about relying too much on the RMA without carefully considering its potential shortcomings.²¹ Some other C⁴ system concerns worthy of addressing include:

- Enemy will exploit system vulnerabilities.
- Enemy will be able to circumvent the system.
- Hardware or software will fail at inopportune times.
- C⁴ technology will work only in a war similar to Desert Storm (i.e., open terrain and cooperative enemy).
- C⁴ system is too expensive—other equipment is more essential.
- C⁴ system will actually increase vice decrease the *fog of war*.

In a recent article, Admiral Owens acknowledged the above concerns, but argued that all those problems were being addressed and were not insurmountable. He also stated that all the hardware and software systems will have a tremendous amount of redundancy built-in. Finally, he added, "... (our) effort follows the same kind of approach used so successfully in the SSBN security program; namely, don't wait until someone else finds a vulnerability—instead, think and work continually to find it and eliminate it, first."²² In short, valid concerns will have to be continuously addressed. A good counter argument is that just as the knowledge and technology exist to create the systems; the knowledge and technology exist to solve the problems.

The Human Aspect. Surprisingly, one of the major obstacles to successful implementation of the C⁴ system is gaining the enthusiasm and support of its potential users. The typical military member is remarkably structured. Service personnel are trained in a structured environment from day one in bootcamp. Because of this focus, there is a conditioned, built-in reluctance for the typical military *warrior* to accept change. Many *warriors* are uncomfortable with and somewhat mistrusting of the current revolution in technology. Technology often involves complex concepts that are foreign to our way of thinking and reasoning. In an interview in 1996, Lieutenant General Albert J. Edmonds, J6 for the JCS, was asked "What is the biggest difficulty in bringing...(the new Defense Message System)²³ ...to the brink of implementation?" He answered, "In a word: acceptance. DMS is a culture change. It's not just implementation of a new system."²⁴ The RMA culture change is one that not all in the military are eagerly embracing. A tremendous amount of training and *hands on* use will be required *to sell* the system to the military *warrior*.

In a recent article in *Parameters*, Captain James Fitzsimonds wrote about another human dilemma—the bridge between the innate technological systems and the human beings who have to successfully employ them. The following quotation succinctly sums up that challenge:

"Beyond the issues of technical capability and cost, the most daunting challenge will likely be that of the profound organizational change needed to exploit fully revolutionary advances in information processing. The most critical drag on high-tempo system performance is the cognitive limit of the human mind, the rate at which an individual can assimilate information and act."²⁵

IMPACT AT THE OPERATIONAL LEVEL

Some Concerns. The framework for the next generation command and control system is almost operational. The introductory *system of systems* envisioned in *C⁴I For the Warrior* is currently being used by several unified commands and has been tested extensively in exercises. As with any new, complex system, there have been some problems and concerns. More concerns are likely to surface as the system becomes fully operational. Thus, many of the future problems will have to be dealt with at the operational level under real world conditions. The following addresses potential problem areas and offer solutions to ensure a smooth and orderly transition of the C⁴ system into 21st Century operations.

Disconnect between levels. Currently, one of the biggest problems at the operational level is configuration management. Procurement is being carefully controlled at the Strategic level by the JROC process, but individual services are still independently acquiring vast amounts of service specific hardware. Not all acquisitions are compatible with the commonality goals of the C⁴ vision. Unfortunately, the Operational Commander and his/her staff are often left to deal with the ramifications.

Two problems are inherent with a horizontal or across service approach for component C⁴ equipment procurement. First, critical resources are squandered when all four services independently attempt to stay abreast of the most current technology. Technology moves so quickly, that C⁴ equipment often becomes obsolete sitting in a box awaiting the completion of a new ship, aircraft, or other major piece of military hardware.²⁶ Secondly, expensive software development is required to *teach* incompatible equipment to *talk* to the strategic system. Civilian contractors are normally required to complete this function. The

contractors rarely provide documentation for this *patch-type* software development and that leads to maintenance concerns later on. Most often the added expense must be born by the Operational Commander until additional funds can be allocated. As stated in an earlier section, to afford the technology, a concerted effort has to be made to reduce the money spent on software error correction.

Information Overload. In July 1988, the Commanding Officer and crew of the USS *Vincennes* misinterpreted information from command and control systems and shot down an Iranian airliner that had been incorrectly identified as a hostile F-14. Raymond Bjorklund addressed the question of whether this incident was caused by too much information in his book, *The Dollars and Sense of Command and Control*. He wrote:

“Unless the human (and non-human) components of the C² system can manipulate and transform the raw data into usable information reflecting the commander’s perception of reality, an overload of raw data will often contribute little more than confusion to the human element of the C² system. Confusion was indeed a factor in command and control that July morning in the Straits of Hormuz.”²⁷

The scenario above or one very similar to it is every commander’s nightmare. The Aegis system on the *Vincennes* is very complex, but pales in comparison with the new C⁴ system. As the complexity of modern warfare increases; the decision time for the operational commander decreases. Can operational mistakes like the one that occurred on *Vincennes* be avoided or are they just part of the cost of doing business in modern warfare? The rapid nature in which electronic information is gathered, compressed, and transmitted allows little time to analyze ambiguities. Can humans control information overload and effectively utilize the new systems? Bjorklund analytically examines these questions in his book and concludes the answer to both is “yes.” He argues that most operational mistakes can be avoided and offers historical proof of proper employment under similar circumstances. In addition, he agrees that training and software tools can minimize the chance of information overload.

Bjorklund concludes that with lower defense budgets, command and control systems actually provide real value for the dollar expended.²⁸

Over-Dependence on System. There is a real fear that the Operational Commander and his/her staff will become so dependent on the accuracy and timeliness of information garnered during training exercises that they will be ineffective during the melee of war.²⁹ Simulation and computer war-gaming certainly have a place, but caution is required to keep from becoming over-confident by measuring skill levels via artificial means. Secondly, there is an overriding fear of a system or human failure at a critical point in the battle. Robust systems, redundancy, and decentralized command and control can alleviate much of this concern.

Another problem is that the quest for more information can become so addictive that it can countermand the decision making process. It sometimes appears that the more information we feed to higher echelons of command; the greater their requirement becomes for producing more information.³⁰ A plethora of information can also lead to temptation by higher levels of command to interfere in tactical situations. The late President Johnson's interference in tactical decisions during the Vietnam Conflict is still fresh in the minds of many in the military today.

Security. Any system that uses telecommunications technology for the delivery vehicle can be vulnerable to counter-warfare by the enemy. The Defense Intelligence Systems Agency (DISA) has been tasked with ensuring systems security for the new C⁴ system. Extensive use of fiber optic cable in vulnerable applications will help mitigate this problem. Another example of innovation that will be an intrinsic part of all future computer-based systems is Personal Computer Memory Card International Association (PCMCIA) technology. Credit card-sized modules will contain both organizational and individual user information. The authorized user will have to insert the card into the PCMCIA slot in the computer and enter a password to gain access.³¹ Similar innovations will be utilized in other C⁴ systems to enhance security.

User Friendly. Systems have to be easy to understand and to use. Icon technology using commercial standards can help significantly in this area. Systems also have to endure the day to day hardships encountered in the operational environment. This is a real concern

considering many of the hardware items are off-the-shelf technology and do not meet DOD durability standards. Off-the-shelf equipment is also not hardened against Electrical-Magnetic Interference (EMI). It is important to control how and where this type of equipment is used. Off-the-shelf equipment may be acceptable in a headquarters or on a ship; with more durable, hardened equipment required on the battlefield.

Training and Maintainability. When non-standardized systems are procured, training and maintenance can quickly become an overriding burden. As both system and decision making task become more complex, a strong training program is critical. Systems will only be as good as their users. Equipment complexity has reached a point where a technician can no longer receive standard military training and be expected to maintain the equipment. Unfortunately, in an effort to stay abreast of technology, C⁴ equipment rapidly reaches obsolescence. The traditional school approach for training just does not suffice. Civilian contractors may then be required and that will cause other quandaries... "Will they go to war?" ... "Do we want them to go to war?"

THE OPERATIONAL CHALLENGE

Centralized or Decentralized? This is a controversial aspect of the new system that may also require a culture change. Many studies agree that a quicker tempo of action will result from the increased awareness of the battlefield. This increased tempo will then by necessity dictate the decentralization of many decisions to the lower levels of command.³² Also, the increased use of speed and synchronization will force hierarchical command structures to become flatter to take advantage of the increased leverage. Automated analysis and decision making will replace time-consuming and error-prone human deliberation.³³ The three levels of war will begin to blend and become more compressed by the enhancements in communications. The Operational Commander will be constantly tempted to go down the continuum to the tactical level. Conversely, the Tactical Commander because of his or her enhanced awareness will be tempted to make operational decisions. Both will have to control their instincts and maintain a strict role balance during the battle problem.

Are The Levels of War Passé? There was a post Desert Storm euphoria that technology would soon blur or erase the distinctions between the levels of war, making their importance no longer a part of the *art of war* equation. The JCS in the *Doctrine for Joint Operations* was more cautious. While acknowledging that "immediate communications may cut across the three levels" it stressed the importance the levels of war concept can have in helping the commander to "visualize a logical flow of operations, allocate resources, and assign tasks to the appropriate command."³⁴ Every Commander will have to face this dilemma sometime. He or she will have to fight the urge to increase centralization of command and control functions because the end result would be a mitigation of the importance of the commander actually on the ground.³⁵

Doctrine. Current doctrine is contained in Joint Pub 6-0, *Doctrine for Command, Control, Communications, and Computer (C⁴) Systems Support to Joint Operations*. The doctrine is generic and generous in its visionary view of how successful the new system will be. One of the most important tasks for the Operational Commander will be to ensure that doctrine is further developed and refined as lessons are learned and that Joint Pub 6-0 is constantly updated. With the advent of the new C⁴ system, the military is in a position to step into a new millennium. Our success will in many ways be measured by the doctrine we develop to fully utilize the new system to the maximum of its capability.

RECOMMENDATIONS AND CONCLUSIONS

Recommendations. The C⁴ effort must remain jointly focused while realizing that there are some fundamental differences between services that will require occasional variance. Procurement and standardization efforts have to be improved. More emphasis must be placed on a vertically vice horizontally focused J6 organization with tighter controls over the individual service's efforts. Software costs have to be contained and controlled.

Training for both operators and maintenance personnel must be continuously stressed and standardized. Just as the old ways of doing business do not work for acquisition, they also do not work for training. Desk top trainers, help menus, and the ability to rapidly update curriculum is a necessity. Training will always pay off during the *heat* of battle.

Strong emphasis must again be placed upon the application of operational art at all levels of command. Detailed planning, execution, and the use of the principles of operational art, will be just as important to overall success as all the technology advances put together. We must never forget the basics and the ultimate importance of human performance in the military equation.

Commanders must allow subordinates to carry out orders without constantly interrupting. Knowing one's mission will be more important than ever. Critical decisions must be made concerning how much information is enough and how much is too much. Command and control functions have to be decentralized vice centralized to allow each level to take full advantage of the new capabilities. Avoiding information overload will require constant attention by everyone involved in the process. Operational security programs have to be continually emphasized with strict adherence to regulations by all personnel the only accepted norm.

Finally, and perhaps most importantly in modern C⁴ warfare, Commanders must be cautious about proceeding beyond the capability of their forces to advance. As our understanding of the battlespace improves, our capacity to use force faster and more precisely over greater distances will dramatically improve.³⁶ Understanding the meaning of the culmination point and not exceeding it in the excitement of battle will ultimately prove to be a critical factor in success.

Conclusion. The C⁴ system has the potential to dramatically change the way our military operates. The system can be just as useful in a war with an aggressor like Iraq as it can during peace operations in Bosnia. Users have to overcome their fear of technology to fully capitalize on the potential of the system. We must never overlook the fact that the C⁴ system is just that, a system. It is the people who operate the system and the quality of the training and education they receive that will make the difference in the end.

“The commander will be faced with a much more complex job; recognizing those simultaneous strategic and tactical events that directly influence strategy, and integrating them at the operational level into the full synchronization calculation that traditionally determined what tactical battles and engagements to join or forego.”³⁷

NOTES

1. Carl Von Clausewitz, On War ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), p. 140.
2. Ibid., p. 117.
3. William A. Owens, "A Report on the JROC and the Revolution in Military Affairs," Marine Corps Gazette, August 1995, p. 47.
4. Office of the Joints Chiefs of Staff, C⁴I for the Warrior (Washington: GPO, 12 June 94), p. 4. Original Source of quote is Fleet Marine Force Manual (FMFM) 3, Command and Control.
5. Office of the Joint Chiefs of Staff, Joint Pub 1.02, Department of Defense Dictionary of Military and Associated Terms (Washington: GPO, 1 Dec 89), p. 77.
6. Office of the Joint Chiefs of Staff, JCS Pub 6-0, Doctrine for Command, Control, Communications, and Computer (C⁴) Systems Support to Joint Operations (Washington: GPO, 30 May 1995), p. GL-5.
7. Ibid., p. inside cover.
8. Office of the Joint Chiefs of Staff, C⁴I for the Warrior, p. 3.
9. Office of the Secretary of the Army, Director of Information Systems Command, Control, Communications, and Computers (C⁴), Army Enterprise Strategy: The Vision (Washington: GPO July 1993), p. 4.
10. Air Force Chief of Staff, Command, Control, Communications, and Computer Plans and Policy Division, Horizon: Air Force C⁴I Strategy for the 21st Century (Washington: GPO, 1993), p.
11. David Jablonsky, "US Military Doctrine and the Revolution in Military Affairs," Parameters, Autumn 1994, p. 23.
12. Office of the Joint Chiefs of Staff, C⁴I for the Warrior, pp. 2-17.
13. William A. Owens, "The Emerging System of Systems," Proceedings, May 1995, p.36.
14. Owens, "A Report on the JROC and the Revolution in Military Affairs," p. 50.

15. Admiral William A. Owens was the first Chairman of the JROC and initiated the "System of Systems" concept. He was Vice Chairman of the JCS from March 1994 until his retirement in the Spring of 1996.

16. Owens, "The Emerging System of Systems," p. 37.

17. Ibid., p. 38.

18. Robert K. Ackerman, "Military Planners Gird for Information Revolution," Signal, May 1995, p. 71.

19. Ibid., p. 76.

20. Owens, "A Report on the JROC and the Revolution in Military Affairs," p. 50.

21. Warren Caldwell, Jr., "Promises, Promises," Proceedings, January 1996, p. 54.

22. Owens, "A Report on the JROC and the Revolution in Military Affairs," p. 51.

23. DMS is short for the Defense Message System which is part of the Midterm Phase of the "C⁴I for the Warrior" concept. DMS is a global secure electronic mail and messaging system that will replace the current AUTODIN system by the year 2000.

24. Diane Hamblin, "Interview with LTG Albert J. Edmonds," CHIPS, January 1996, p. 5.

25. James R. Fitzsimonds, "The Coming Military Revolution: Opportunities and Risks," Parameters, Summer 1995, p. 23.

26. Jeremy M. Boorda, "Leading the Revolution in C⁴I," Joint Forces Quarterly, Autumn 1995, p. 16.

27. Raymond C. Bjorklund, The Dollars and Sense of Command and Control, Washington: National Defense University, 1994, p. 12.

28. Ibid., p. 22.

29. Jablonsky, p. 26.

30. Kenneth F. McKenzie, JR., "Beyond Luddites and Magicians: Examining the MTR," Parameters, Summer 1995, p. 18.

31. "From the Cold War to the Global Information Age," Defense Issues, V. 10, no. 34, pp. 3-4.

32. Jablonsky, p. 28.

33. Fitzsimonds, p. 33.

34. Jablonsky, p. 24. Quote from Office of the Joint Chiefs of Staff, JCS Pub 3.0, Doctrine For Joint Operations (Washington: GPO, 30 May 1995), p. II-2.

35. McKenzie, p. 17.

36. Owens, "A Report on the JROC and the Revolution in Military Affairs," p. 49.

37. Jablonsky, p. 25.

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